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THE EFFECTIVENESS OF STUDENT WORKSHEETS WITH PROBLEM SOLVING MODELS TO TRAIN STUDENT'S REASIONING

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ABSTRACT

This study aims to describe the effectiveness of Student Worksheets with Problem Solving Model in Exercising Student Reasoning on Pressure Materials through pretest and posttest. The type of research refers to the One Group Pre-test Post-test Design research design. The developed worksheets apply three pressure fields, namely hydrostatic pressure, pascal law and archimedes law. The results of effectiveness in training students' reasoning can be seen through increasing student n-gain and reasoning indicators. There are two reasoning indicators that experience an increase in medium category gain and two other indicators in the high category. The indicator explains the relationship between the elements of the problem has a medium category with a gain score of 0.54, the indicator plans and constructs arguments has a high category with a score of 0.75, the indicator composes and checks the correctness of the guesses in the medium category with a score of 0.69 and indicator of ability to draw conclusions in a high category with a score of 0.78. Based on the results of the study it can be concluded that Student Worksheets with Problem Solving Model are effectively used as learning tools in training students' reasoning

Keywords: *Student's Worksheet, Problem Solving, Reasoning*

INTRODUCTION

The 21st century requires a life that must master various skills, most of which focus on thinking skills, communication and learning. Students are not only enough to learn about basic knowledge, but also need to learn critical thinking to make students able to analyze, reason and solve problems educatedly (Saavedra and Opfer, 2012).

One of the learning systems currently being developed by Indonesia is the 2013 Curriculum, this learning system supports the existence of demands in the 21st century, which must master some of the skills mentioned above and apply student-focused learning (student center). Learning using the 2013 curriculum aims to encourage students to be better at conducting learning activities, such as observing, having reasoning power, and being able to communicate, ask questions or answer (Hadi, 2016).

The results of research conducted by The Trends in the International Mathematics and Science Study (TIMSS) in 2015 showed the results of science learning in Indonesia ranked 45th out of 48 countries. A measured test in TIMSS are content aspect and cognitive aspect, namely life science, physical science, art science, knowing, applying and reasoning. Among these levels, the ability of reasoning or reasoning of students is the lowest. According to the Ministry of Education and Culture, Indonesian students need to reinforce their ability to integrate information, draw conclusions, and generalize their knowledge to other things (Kemendikbud, 2014).

Learning that is suitable to be applied in the 21st century is a student-centered learning method, one of which is Problem Based Learning which allows students to collaborate, communicate, reason, work on a problem and engage with society (Rotterham and Daniel, 2009). One of the problem based learning models is problem solving learning model. In solving problems students need several strategies such as the ability to reason in sorting out the causes of the problem, and the need for cooperation in considering the different perspectives of peers and the need for exploration.

Based on the results of research conducted by Nor Soleh and friends, namely by comparing the use of

CTL learning models with MEAs (Model Eleciting Activities). The results showed that deductive reasoning abilities conducted at Ulujami 2 Public Middle School contributed 71.3% of students' problem solving abilities, while 28.7% were influenced by other factors.

The pre-study results of class VIII D at SMPN 2 Menganti, the percentage of the results of students' reasoning tests in the aspects of connecting the problem elements was 23.3%, aspects of preparing and checking the presumption of truth were 66.7%, interesting aspects of an argument amounting to 58 , 4%, and the concluding aspect of the statement was 46.7%. The results of general reasoning ability are 48.8%, so the researchers conclude that the reasoning of class VIII D students in Replace SMPN 2 is still low. This is also supported by the results of interviews with one teacher stating that students are still having difficulties when invited to reason in solving a problem, this is seen through the time needed to answer the teacher's questions quite long.

Based on the results of interviews with class VIII science teaching and learning teachers, at the time of learning the methods used were still dominated by lecture, discussion, and question and answer methods. However, teachers have never used learning tools in the form of LKS (Student Worksheets). This is due to the government's prohibition on using LKS, while from the teacher's side it also does not provide or develop LKS in other forms. Science teachers at Menganti SMPN 2 are guided by textbooks without any other device or media allowances. As we know that science learning has the characteristics of 5M and doing an experiment. The use of textbooks without LKS support will cause students difficulties in conducting experiments, so the LKS is needed to support science learning so students are better able to explore the material of science they learned.

. Suyitno said that LKS is one of the good learning alternatives to help students add information and understand concepts learned through systematic learning activities (Farid, 2010). Whereas one of the objectives of designing worksheets according to the Ministry of National Education is as reinforcement in learning (Ministry of National Education, 2008). It can be said that the learning process has not been fully maximized, because the learning media are inadequate in supporting the learning process, so the teacher experiences difficulties. Therefore it is necessary to do an innovation in order to train students' reasoning, especially on pressure material.

The development of student worksheets (LKS) in this study for liquid pressure material whose emphasis is on sub-material Pascal's Law, Hydrostatic Pressure and Archimedes' Law. LKS uses the IDEAL problem solving model which will contain realistic problems that are in everyday life. The problem solving learning goal itself is to instill systematic and logical student thinking in the face of a problem, and be able to solve these problems through exploration of empirical data (Indrayani, 2005). While the reasoning indicators which is used are the ability to connect the elements of the problem, the ability to arrange and check the alleged truth, the ability to draw the validity of an argument and the ability to draw conclusions from statements.

Based on the description of the background above, the writer carried out a development research entitled "The Effectiveness of Student Worksheets with a Problem Solving Model to Practice Student Reasoning".

METHODS

This study applies the One Group research design Pre-test Post-test Design with the pattern described as follows:

O_1	X	O_2

O_1 = Pre-test
O_2 = Post-test
X = Treat by using Student Worksheet

Before conducting research based on effectiveness, Student Worksheets with Problem Solving models must have done theoretical validation measured from the perspective of experts. If the developed media is said to be feasible, then research can be processed to the student worksheets effectiveness stage. Research on the effectiveness of Student Worksheets with Problem Solving models is done through a sheet of pretest and posttest conducted at Menganti SMPN 2 class VIII-D which amount to 30 students in the 2018/2019 school year.

The data collection method used in this study is written test method which is used to determine students' reasoning abilities after using the worksheets with the Problem Solving model. The initial pretest test was carried out before learning using worksheets while the posttest was given after the worksheets given with the Problem Solving model on pressure material during learning.

The data analysis technique used is analysis of the test sheet. Analysis of student reasoning data is done by checking student learning outcomes that are used to measure the effectiveness of LKS used in learning. Data obtained based on the results of student knowledge tests. The value used for data on the effectiveness of this LKS is the value of the pretest and posttest which will be analyzed for increasing the learning outcomes to determine the students' reasoning abilities. Reasoning students are said to be trained if they experience an increase in gain. To calculate the value obtained by students, we can use the equation below:

$$student\ value = \frac{score\ obtained}{maximum\ score} \times 100\%$$

After the students' score from the learning outcomes is known, then the calculation is carried out to determine the increase in student learning outcomes which is seen from the value of the pretest and the posttest by doing N-Gain analysis using the equation below:

$$< g >= \frac{posttest - pretest}{100 - pretest}$$

Then do calculation using these equations, the scores obtained by students will be converted based on the following criteria:

Tabel 1. Crieria of N-Gain Score

Skor	Kriteria
0,0 < (<g>) ≤ 0,3	Low
0,3 < (<g>) ≤ 0,7	Medium
0,7 < (<g>) ≤ 1,0	High

With these gain score criteria, Student Worksheets with Problem Solving models on pressure material are said to be feasible if the results of student learning gain have score 0.0 <(<g>) ≤ 1.0.

RESULTS AND DISCUSSION

The effectiveness of student worksheets in learning is seen from whether or not the student worksheet can achieve the achievement of learning indicators found in the KD and student worksheet indicators. The effectiveness of this student worksheet is obtained through the success of worksheet in training students' reasoning which is seen through the value of the pretest and posttest which will be analyzed by N-Gain achieved by students.

The reasoning indicator used by the researcher reflects the ability of students in (1) linking the relationship between the elements of the problem, (2) planning and contracting an argument, (3) submitting and examining the alleged truth, and (4) the ability to make conclusions. In the taxonomy bloom revision, the reasoning indicators are used at levels C4 (analysis) and C5 (Evaluation) which are high level cognitive levels that fall into the category of High Order Thingking Skill. The following is the acquisition of Gain increases for each reasoning indicator used:

Tabel 2. Gain Analysis of Each Indicator

Indicator	Pre Test	Post Test	Gain	Criteria
1. Linking The Relationship Between The Elements Of The Problem	59	81	0,54	Medium
2. Planning And Contracting An Argument	55	89	0,75	High
3. Submitting And Examining The Alleged Truth	61	88	0,69	Medium
4. The Ability To Make Conclusions	63	92	0,78	High

According to Priatna (2012) reasoning is a way of someone's thinking skill in connecting two or more elements based on certain properties that have been known to be truthful using steps of proof so that conclusions can be made. Whereas problem solving ability is if students can solve a problem using their reasoning (Hudiono, 2007).

Student learning outcomes are obtained through the pretest and posttest sheets which are in the form of 4 essay questions, each of which represents one indicator of reasoning. Giving a score on each question is adapted to the assessment rubric that has been made, then the score obtained will be compared with KKM (Minimum Completion Criteria) set by Replace SMPN 2. The results of the pretest and posttest can be a reference to see the success of LKS in training students' reasoning.

Student worksheets with problem solving models can develop students' problem solving abilities while training students' reasoning in solving these problems. This is evidenced from the increased learning outcomes after the implementation of the LKS with a problem solving model, where the posttest results of students obtain a higher value than the pretest value, and the value has achieved mastery learning. The following is a table of results of pretest, posttest and N-Gain students:

Tabel 3. Pretest-Posttest Results Analysis of Student Reasoning

Student	Value		N-Gain	Criteria
	Pretest	*Posttest*		
S1	45	75	0,55	MEDIUM
S2	70	90	0,67	MEDIUM
S3	35	90	0,85	HIGH
S4	60	85	0,63	MEDIUM
S5	40	85	0,75	HIGH
S6	75	90	0,60	MEDIUM
S7	60	90	0,75	HIGH
S8	60	90	0,75	HIGH
S9	65	75	0,29	LOW
S10	60	80	0,50	MEDIUM
S11	60	95	0,88	HIGH
S12	70	95	0,83	HIGH

Student	Value		N-Gain	Criteria
	Pretest	*Posttest*		
S13	45	70	0,45	MEDIUM
S14	70	90	0,67	MEDIUM
S15	60	85	0,63	MEDIUM
S16	35	55	0,31	MEDIUM
S17	55	95	0,89	HIGH
S18	70	95	0,83	HIGH
S19	50	95	0,90	HIGH
S20	60	100	1,00	HIGH
S21	70	85	0,50	MEDIUM
S22	75	95	0,80	HIGH
S23	70	85	0,50	MEDIUM
S24	45	80	0,64	MEDIUM
S25	75	80	0,20	LOW
S26	90	95	0,50	MEDIUM
S27	55	95	0,89	HIGH
S28	50	95	0,90	HIGH
S29	70	100	1,00	HIGH
S30	50	90	0,80	HIGH

The pretest results showed that only one student achieved mastery learning, which was 90, while 29 other students did not complete the score below the KKM <76. The results of this pretest show that students' reasoning on the subject of liquid pressure is still low and had not been well controlled, so that a learning device is needed to help students develop their reasoning abilities. The device in question is worksheets with a problem solving model to train students' reasoning on pressure material.

Problem-based learning model, namely the problem solving learning model, emphasizes learning that increases the ability to think actively in solving problems objectively, so that it can help to improve students' reasoning and learning outcomes (Hidjrawan, 2016).

The worksheets is given to students in class VIII-D SMP 2 Menganti is able to attract students' interest in learning, so students have high motivation in participating in teaching and learning activities. This is in accordance with what Heriyati (2017) said, which states that motivation plays an important role in the success of student learning, student interest and motivation to learn is very influential on student outcomes and achievements. Fauziah, et al. (2017) stated that 79.1% of students' motivation was influenced by students' interest in learning.

The interest of students of class VIII-D of SMPN 2 Menganti can be seen through the positive response of students who stated that 100% of students agreed to have an interest in studying LKS. It can also be seen through students activity which as a whole shows that students are active in learning, where student activities score 87% - 100%. Based on the activities of these students can show that students have a high interest in following the learning process. The formation of interest in a person arises because of the interest and attention to one particular thing accompanied by feelings of pleasure, so that if students are interested in a lesson then he will try and be motivated to do something that interests him (Heriyati, 2017).

The first indicator is to relate the relationship between elements of the problem, there is an increase in gain of 0.54 with the medium category. Linking the relationship between elements of the problem is the ability to use and analyze the relationships of several elements that exist in the problem given (Rahayu, 2017). The indicator gained the lowest gain among other indicators. This shows that students in class VIII-D of SMPN 2 Menganti experienced a low increase among other indicators, this happened because the value of the students' pretest and posttest did not change significantly.

When seen through the LKS assessment, in the activity of analyzing the problem, students get the lowest percentage among other activities. This supports why indicator 1 gains the lowest gain, namely students are still confused and have difficulty in analyzing problems, so that students' understanding still needs to be considered. As for other things that cause students difficulties in relating the relationship between the elements of the problem, namely (1) students are still confused in organizing the elements of the existing problems; (2) students still have difficulty in making work procedures and calculations; and (3) students are not aware of the diversity of problems in a given case (Bransford, 1984).

The increase in gain on the first indicator can be supported by teacher guidance to students in identifying each element of the problem that exists, then students are asked to purify these problems by connecting with each other the problem elements into a problem statement. This is supported by the learning implementation data in the Identify Problem step which shows that learning has been done very well which gets a percentage of 94% - 98% in meeting 1 to meeting 3. As well as student activity during learning which shows that activities observe problems obtain a percentage 100% and the activity of identifying problems into several elements gets a percentage of 92%.

The second indicator is planning and constructing arguments, where the gain obtained is 0.75 with a high category. According to Rahayu (2017), what is meant by planning and constructing arguments is that students present evidence of the truth of a statement based on the concepts and knowledge they have. The question given in this second indicator asks students to submit their arguments to a statement, whether the

statement is true or false, so that at this stage requires students to use the concept and reasoning well.

On indicators planning and constructing arguments there is a high increase, because students get meaningful learning through practicum, so students can construct their understanding of the material of pressure by reasoning. This is supported by the results of student activities which show that as much as 90% of students conduct investigations and collect data, so students get their learning and knowledge through these investigations that can support the success of student learning. The results of the student experiment data are also quite good when reviewed through the assessment of student worksheets, this shows that students have experimented and obtained accurate data, so that students have obtained direct and meaningful learning.

The second indicator stage is that students are asked to use their reasoning and understanding on liquid pressure material to construct correct arguments and strategies, so that there is a match and balance between reasoning and understanding. These results are supported by students' responses stating that 97% of students claim to be able to make strategies and provide arguments correctly. The increase in gain on the indicator plans and constructs the argument reaches 0.75 in the high category. This shows that the ability to plan and construct arguments for students is well trained. Killpatrick and Findell (2001) say that students will demonstrate their reasoning ability if they have sufficient basic knowledge before entering new knowledge.

The third indicator is compiling and checking the truth of the allegations that get an increase in gain of 0.69 with the medium category. Arranging and examining the alleged truth is the ability of students to make possible guesses in a problem by looking at the order that is in the problem (Rahayu, 2017). In this case, students are given two or three possibilities in a problem and students are asked to give their guesses on which possibilities are correct. Hernadi (2008) argues that a guess can be arranged by linking all existing information, so that from the information students can provide reasons that can strengthen their allegations.

The increase in gain reasoning in the indicators compiles and checks the alleged truth in the medium category. If reviewed through the assessment of each LKS, the activity of analyzing data and strategies gets a percentage of 86% - 88%, this indicates that the percentage is included in the lower scope when compared to other activities. The LKS assessment can support the reason why this third indicator falls into the medium category, that is, students are still not maximal in proving allegations on the strategies made. Based on the results of data analysis and student activities, there are several factors that influence, namely (1) students are less able to communicate ideas and understandings that are owned in writing or verbally and (2) do not understand the conditions of the problem given. Espita, et al (2012) which states that student learning activities have an important role in student learning outcomes, if student activities are low, the learning outcomes will also be low.

The fourth indicator is the ability of students to draw conclusions that have a gain score of 0.78 with a high category. Among the four reasoning indicators used, it is this ability to draw conclusions that gets the highest gain. The ability to draw conclusions is shown by drawing a conclusion by linking things obtained from the beginning to the end of learning based on the problems given (Rahayu, 2017). Attracting conclusions is an activity where students are asked to relate to each other the existing problems with how they are resolved. Based on the results of student questionnaire responses, as many as 100% of students claimed to be able to conclude the results of the resolution of a problem.

Based on the results of the student LKS assessment, it shows that the activity of making conclusions gets a percentage of 100%, this shows that each student has succeeded in making conclusions properly and correctly based on the problems given. Drawing conclusions is a common thing students do in learning but still needs to be honed. Student experience is important in the formation of basic knowledge of students. This is in accordance with the results of Handayani's research (2015), which states that learning experiences have a direct influence on student learning achievement. In addition, high gain is also influenced by student activity at the stage of making conclusions, the percentage of student activity makes a conclusion reaching 92% so that in broad outline all active students contribute in concluding the results of the experimental data they get. With the issuance of problem-based LKS, students are taught and guided to solve these problems with their reasoning and make conclusions, so the ability to make conclusions students are also trained.

The results of the N-Gain analysis of each student have good results, namely an increase in the low to high categories. Of the 30 students who took part in the study, 15 students received an increase in Gain with a high category, 13 students with a moderate category and 2 students got a gain in the low category. There were two students who experienced an increase in low gain, namely S9 and S25.

In S9 students get a low pretest value and the increase in the posttest is also low so it does not experience a large increase in gain. This can be caused by student activities during learning, where he does not pay attention to the teacher and does not follow the learning

steps according to the implementation plan of learning. These students actually do other activities outside the learning context, where the percentage of student activity during learning scores 59%. Teachers are also less able to condition the students so that students do not respond to the questions asked by the teacher.

In S25 students have a low gain because from the beginning the pretest students have obtained a pretty good value approaching the maximum value, so that when the posttest students get a higher value than before but not much different from the value of the pretest. As shown by the results of Astuti's study (2015), students' initial knowledge influences the success of students in learning physics, namely there is a linear effect on the initial ability of student learning achievement. The activities carried out by the S25 during learning are good enough, where they get a percentage of 85%, so that the activity of these students can contribute to the success of students in learning.

Student worksheets with Problem Solving Model is effective to train students' reasoning on pressure material. The LKS has successfully trained students' reasoning seen through the acquisition of a gain score on all reasoning indicators applied in this study. The gain score obtained shows an increase in gain scores on reasoning indicators with a score of ≥ 0.54 which falls into the medium to high category. The highest gain score is obtained from the concluding indicator with a gain score of 0.78 high category and the lowest is obtained on the indicator explaining the relationship between the problem elements with a gain score of 0.54 medium categories. While indicators planning and constructing arguments get a score of 0.75 high categories and indicators compile and check the correctness of estimates of 0.69 medium categories.

Suggestion

Based on the research that has been carried out, it is suggested that the learning process should pay attention to the absorptive power and comprehension power of students, so that learning can run optimally which will have an impact on the effectiveness of the worksheet developed.

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